What is claimed is:

1. An electromagnetic radiation source, comprising:

an anode and a cathode separated by an anode-cathode space;

electrical contacts for applying a dc voltage between the anode and the cathode and establishing an electric field across the anode-cathode space;

at least one magnet arranged to provide a dc magnetic field within the anode-cathode space generally normal to the electric field;

a plurality of openings formed along a surface of the anode which defines the anode-cathode space, whereby electrons emitted from the cathode are influenced by the electric and magnetic fields to follow a path through the anode-cathode space and pass in close proximity to the openings;

a common resonator which receives electromagnetic radiation induced in the openings as a result of the electrons passing in close proximity to the openings, and which reflects the electromagnetic radiation back towards the openings and produces oscillating electric fields across each of the openings at a desired operating frequency.

2. The source of claim 1, wherein the oscillating electric fields are 180 degrees out of phase with respect to adjacent openings.

3. The source of claim 1, wherein the anode comprises a plurality of waveguides, and one end of each waveguide serves as one of the openings and another end of each waveguide opens into the common resonator.

4. The source of claim 3, wherein adjacent openings along the surface of the anode-cathode space are formed by waveguides having different electrical lengths at the operating frequency.

5. The source of claim 4, wherein the waveguides having different electrical lengths are comprised of waveguides having different dimensions.

6. The source of claim 5, wherein the different dimensions are in the H-plane.

7. The source of claim 5, wherein the different dimensions are a result of the waveguides having different lengths.

8. The source of claim 4, wherein the difference in electrical length is equal to about one-half λ, where λ represents the wavelength of the operating frequency.

9. The source of claim 1, wherein:

the cathode is cylindrical having a radius rc;

the anode is annular-shaped having a radius ra and is coaxially aligned with the cathode to define the anode-cathode space with a width wa=ra-rc; and

a circumference 2 π ra of the surface of the anode is greater than λ, where λ represents the wavelength of the operating frequency.

10. The source of claim 1, wherein the anode comprises a plurality of wedges arranged side by side to form a hollow-shaped cylinder having the anode-cathode space located therein, and each of the wedges comprises a first recess which defines at least in part a waveguide having an opening exposed to the anode-cathode space.

11. The source of claim 1, wherein the anode comprises a plurality of electrodes positioned in a pattern and spaces between the electrodes form the openings.

12. The source of claim 11, wherein the pattern is a circle.

13. The source of claim 12, wherein the electrodes are positioned in a circle around the cathode.

14. The source of claim 11, wherein the electrodes are interdigitated.

15. The source of claim 11, wherein the electrodes comprise a plurality of pins.

16. The source of claim 15, wherein the pins are arranged in a circle around the cathode.

17. The source of claim 16, wherein the pins are coupled to a fixed dc potential.

18. An electromagnetic radiation source, comprising:

an anode and a cathode separated by an anode-cathode space;

electrical contacts for applying a dc voltage between the anode and the cathode and establishing an electric field across the anode-cathode space;

at least one magnet arranged to provide a dc magnetic field within the anode-cathode space generally normal to the electric field;

an array comprising N pin-like electrodes forming at least a part of the anode and arranged in a pattern to define the anode-cathode space; and

at least one common resonant cavity in proximity to the electrodes,

wherein the electrodes are spaced apart with openings therebetween, and electrons emitted from the cathode are influenced by the electric and magnetic fields to follow a path through the anode-cathode space and pass in close proximity to the openings to establish a resonant electromagnetic field within the common resonant cavity.

19. The source of claim 18, wherein the cathode is generally cylindrically shaped about an axis, and the electrodes form a cylindrical cage coaxially around the cathode.

20. The source of claim 19, wherein the electrodes form a plurality of cylindrical cages aligned coaxially around the cathode, the plurality of cylindrical cages being stacked one upon another.

21. The source of claim 21, wherein the electrodes are aligned parallel with the axis.

22. The source of claim 19, wherein N/2 of the electrodes originate from a lower part of the anode-cathode space and the remaining N/2 of the electrodes originate from an upper part of the anode-cathode space.

23. The source of claim 22, wherein the electrodes originating from the lower part of the anode-cathode space are interdigitated with the electrodes originating from the upper part of the anode-cathode space.

24. The source of claim 23, wherein the electrodes are tied to a fixed dc potential to establish the electric field, and an ac potential is induced on the electrodes by the resonant electromagnetic field.

25. The source of claim 24, wherein the ac potentials induced on adjacent interdigitated electrodes are respectively 180 degrees out-of-phase.

26. The source of claim 23, wherein the electrodes are patterned from a conductive layer formed on a tube.

27. The source of claim 23, wherein the upper and lower parts of the anode-cathode space are respectively defined by upper and lower magnetic pole pieces.

28. The source of claim 27, wherein the electrodes are electrically and mechanically coupled to a corresponding pole piece.

29. The source of claim 27, wherein the electrodes are electrically isolated from a corresponding pole piece.

30. The source of claim 27, wherein the pole pieces define a waveguide between the electrodes and the common resonant cavity.

31. The source of claim 30, wherein the waveguide is approximately an integer multiple of $\lambda/2$ in length, where λ is the wavelength of the frequency of the resonant magnetic field.